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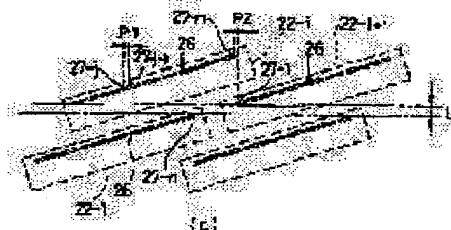
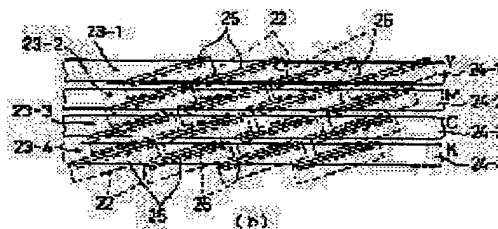
(72)Inventor : INOUE HIDEAKI

(54) MULTI-ARRAY INK JET PRINT HEAD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a multi-array ink jet print head provided with a minimum number of ink supply passages and having a narrow width in the short side direction.

SOLUTION: Nozzle arrays 26 are arranged on the master substrate 21 of a print head 20 while inclining at an angle θ wherein thirteen print chips 22 in an array constitute a subhead 23 (23-1, 23-2, 23-3 or 23-4). Vertically or laterally adjacent print chips 22 are interlaces obliquely between subheads 23 and no useless gap is present. The print head 20 has width J in the short side direction which is narrower than that of a conventional multi-array print head. Each subhead 23 corresponds to one ink supply passage 24 (24-1, 24-2, 24-3 or 24-4) and total four ink supply passages 24 communicate, respectively, with four ink storage chambers of yellow Y, magenta M, cyan C and black K of one ink tank.



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CLAIMS

[Claim(s)]

[Claim 1] The sub head which arranges two or more printing chips which have arranged two or more ink regurgitation nozzles in the shape of a straight line with the predetermined angle θ (however, $\theta \neq 0$) to the predetermined direction, and changes, and the multi-array formula ink-jet print head which arranges two or more these sub heads in the right-angled direction to the aforementioned predetermined direction, and changes.

[Claim 2] The aforementioned predetermined direction is a multi-array formula ink-jet print head according to claim 1 characterized by being the main scanning direction of printing.

[Claim 3] The aforementioned predetermined direction is a multi-array formula ink-jet print head according to claim 1 characterized by being the direction of vertical scanning of printing.

[Claim 4] The aforementioned predetermined angle θ is a multi-array formula ink-jet print head according to claim 1 characterized by being 5 times or more and 45 degrees or less.

[Claim 5] Two or more aforementioned printing chips arranged at the one aforementioned sub head are multi-array formula ink-jet print heads according to claim 1, 2, 3, or 4 characterized by sharing exclusive use and a single ink supply way.

[Claim 6] The aforementioned ink regurgitation nozzle is a multi-array formula ink-jet print head according to claim 1, 2, 3, 4, or 5 characterized by consisting of the 2nd train which only the predetermined distance a shifted to the longitudinal direction of the 1st train and this 1st train within the aforementioned printing chip, and only the predetermined distance b left in the direction of a short hand of the 1st train of the above.

[Claim 7] The distance f of a direction right-angled in the aforementioned predetermined direction between the ink regurgitation nozzle of the toe of the 1st train of the above in the aforementioned printing chip, and the ink regurgitation nozzle of the toe of the 2nd train of the above. The distance g of a right-angled direction in the aforementioned predetermined direction between the ink regurgitation nozzles of the heel of the 1st train of the above of the printing chip which adjoins in the aforementioned predetermined direction of the ink regurgitation nozzle of the heel of the 2nd train of the above, and this printing chip. The multi-array formula ink-jet print head according to claim 6 characterized by being a repeat range " $f=g$."

[Claim 8] the aforementioned ink regurgitation nozzle — the inside of the aforementioned printing chip — the 1st vertical 4 train — this — the multi-array formula ink-jet print head according to claim 1 characterized by consisting of the 2nd vertical 4 train which only the predetermined distance j shifted to the longitudinal direction of the 1st vertical 4 train, and only the predetermined distance k left in the direction of a short hand of vertical 4 train of the above 1st

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the multi-array formula ink-jet print head to which the ink supply way formed in the longitudinal direction of a parent substrate changes only from one for every color.

[0002]

[Description of the Prior Art] There is an ink jet printer which prints by breathing out the ink of an ink bottle to a form side conventionally. An ink jet printer records the character and picture according to printing information by the print head equipped with the printing element of a large number formed in 300dpi (dot per inch) or the detailed resolution beyond it (printing, printing).

[0003] The record method by the ink jet printer The small substrate of the letter of a chip Make the ink regurgitation side of (calling it a printing chip hereafter) breathe out the drop of ink from the detailed nozzle arranged. [many] In this ink drop (printing dot), make it reach the target, it is made to absorb, this records a character, a picture, etc., recorded materials, such as paper and cloth, have [the regurgitation and] little generating of noise, and full color record is also the comparatively easy record method, without requiring special fixing processing.

[0004] Full color record is performed using the ink of four colors which added the black usually used for a character, the black portion of a picture, etc., using the ink of three colors of the yellow (yellow) which is subtractive primary colors, a Magenta (red color name), and cyanogen (blue with greenishness).

[0005] An ink chamber is made to produce the pressure by the mechanical deformation, using electric machine sensing elements, such as a PIEZO resistance element (piezoelectric device), as a method of making the drop of ink breathing out. A heater element is allotted to the piezo jet method which makes a drop breathe out from a minute nozzle by this, and a detailed ink room. Give this an electric pulse, the interface of ink and a heater element is made to generate a foam at high speed, and there is a thermal jet method which makes a drop breathe out from a minute nozzle similarly using the growth force of the foam.

[0006] Moreover, the above-mentioned thermal jet method has two kinds of composition with the discharge direction of an ink drop. One is the side shooter type of composition of carrying out the regurgitation of the ink in the direction parallel to the exoergic side of a heater element, and other one is a roof shooter type which carries out the regurgitation of the ink in the direction perpendicular to the exoergic side of a heater element.

[0007] There is the method of forming at a monolithic the drive circuit and ink supply way which drive two or more heater elements and these separately using silicon LSI formation processing technology and a thin film coating technology as a process of the printing chip used for such a roof shooter type thermal ink jet printer, and an ink regurgitation nozzle on one silicon chip substrate.

[0008] According to this method, when resolution creates the printing chip of 360dpi (dot per inch), for example on a 10mmx15mm silicon chip substrate, 128 heater elements, drive circuits, and ink regurgitation nozzles can be formed.

[0009] Drawing 6 (a) It is the plan showing the ink regurgitation side of such a printing chip, and

is this drawing (b). It is the rear view. Moreover, this drawing (c) This drawing (a) It is the enlarged view in which removing the orifice plate of the portion squarely surrounded with the alternate long and short dash line a, and showing the interior, and is this drawing (d). This drawing (c) It is an A-A' cross-section view view.

[0010] This drawing (a) The shown printing chip 1 is 4 train preparation ***** about the nozzle train 2 on one silicon chip substrate 3. The nozzle train 2 of these 4 train is constituted so that the regurgitation of yellow ink (Y), Magenta ink (M), cyano ink (C), or the black (K) ink may be carried out, respectively.

[0011] this drawing (a) - (d) the ink receipt which the drive circuit 4 is formed in the upper surface of the silicon chip substrate 3 by LSI formation processing technology, the printing chip 1 is drilled by for example, wet etching, and the ink supply slot 5 opens it for free passage into this ink supply slot 5, and carries out opening to the rear face of the silicon chip substrate 3 so that it may be shown — the hole 6 has penetrated the silicon chip substrate 3

[0012] Between the above-mentioned drive circuit 4 and the ink supply slot 5, by the thin film coating technology by photo lithography technology etc. Many heater elements 7 are formed for 64 pieces, 128 pieces, or 256 etc. pieces. Furthermore, common electrode 8a and individual wiring electrode 8b are connected to these heater elements 7 as a wiring electrode 8, the electrode terminal 4-1 of the drive circuit 4 is connected to the individual wiring electrode 8b, and the electrode terminal 10 for connection with the exterior is formed in the marginal part 9 of the upper and lower sides of silicon chip substrate 3 front face, respectively.

[0013] And on these, the laminating of the septum 11 is carried out all over removing the electrode-terminal 10 above-mentioned portion for connection. The septum 11 formed the ink seal wall which intercepts ink from the outside to the left of the ink supply slot 5 by one side, the ink seal wall which similarly intercepts ink from the outside on individual wiring electrode 8b and the drive circuit 4 on the other hand was formed, and the septum 11 of this individual wiring electrode 8b portion is further equipped with the protrusion section 11-1 which begins to be extended between each heater element 7 and a heater element 7. The configuration in which the protrusion section 11-1 which begins to be extended between each heater element 7 the drum of a comb, then after this is equivalent to the gear tooth of a comb in the portion on above-mentioned individual wiring electrode 8b of a septum 11 and the drive circuit 4 is made. Thereby, the detailed ink pressurized room 12 to which a heater element 7 is located in the root portion between the gear tooth and gear tooth is divided and formed only for the number of heater elements 7 by using the gear tooth of this comb as a bridgewall.

[0014] Furthermore, the laminating of the orifice plate 13 is carried out to the best layer of the silicon chip substrate 3 in which these drive circuits 4, a heater element 7, common electrode 8a, individual wiring electrode 8b, and the septum 11 were formed, many ink regurgitation nozzles 14 are drilled in the position which counters the above-mentioned heater element 7 of the orifice plate 13, and the nozzle train 2 of four trains mentioned above is formed. The nozzle train 2 of four trains is mutually parallel, and is formed, and the ink regurgitation nozzle 14 of an edge keeps step with the same height, and is formed mutually. That is, the nozzle train 2 of four trains is formed so that there may be no gap of the upper and lower sides mutually.

[0015] In now, the resolution of such a printing chip 1, i.e., the arrangement pitch of the ink regurgitation nozzle 14, is very common, and its 600dpi is common in the thing of 300dpi (dot per inch) and high resolution. When 600dpi is seen by milli conversion, the printing element which consists of about 24 the heater elements 7 and the ink regurgitation nozzles 14 per mm will be located in a line with a single tier, and the pitch is about 42 micrometers.

[0016] In such a configuration, the printing chip 1 is completed on the silicon chip substrate 3 of a large number on a non-illustrated silicon wafer. And finally, a dicing saw etc. and it divides individually for every chip substrate unit, and dice bonding is carried out to a mounting substrate, terminal strapping is carried out to it, and it becomes the printing chip of a practical unit. [use and]

[0017] this — printing — a chip — one — the exterior — from — ink — receipt — a hole — six — supplying — having — ink — ink — supply — a slot — five — minding — ink — a pressurized room — 12 — supplying — having — printing — facing — a heater element —

seven — printing — information — responding — alternative — energizing — having — an instant — generating heat — ink — film boiling — a phenomenon — generating — making — the — a nucleus — a foam — a pressure — a

[0018] Generally, a printer can be classified into a serial formula and a line formula as a constitutional classification. By the serial formula, although the above-mentioned printing chip 1 was conventionally used in many cases alone as the print head, by recent years, the print head which has arranged two or more printing chips 1 in the direction of vertical scanning of printing, and long-picture-ized them in it is being put in practical use. The reason for arranging two or more small printing chips 1, and long-picture-izing them is that it cannot make the printing chip of a simple substance from a long picture since various limitations are in the processing technology (mainly processing equipment) of the printing chip 1.

[0019] The printing speed of a printer is influenced by whether to have many printing chips 1 arranged or the printer of the above-mentioned serial formula is few. Of course, since the width of face (dip) of the direction of vertical scanning which the way with many printing chips 1 arranged to the longitudinal direction of a nozzle train prints by horizontal scanning once spreads, printing processing becomes high-speed. On the other hand, the printer of a line formula is a method which fixes the print head to the main part side of a printer using the print head which arranged and long-picture-ized the printing chip 1 to the limit of the printing area of main scanning direction, and conveys only a form, the method itself corresponds to rapidity, and a mechanical load is [it is small, there is little power consumption, and] also economical [the printer].

[0020] therefore, like recent years, in order to meet the request of wanting to make it high speed more, the speed of printing processing In the case of the printer of a serial formula, in order to perform long printing of a dip as much as possible by printing of horizontal scanning of one line It is indispensable work from the start for it to be necessary to inherit two or more printing chips in the direction of vertical scanning, and to form a long print head in the direction of vertical scanning and, to inherit two or more printing chips to main scanning direction, when it is the printer of a line formula, and to form a print head.

[0021] But by the printer of a serial formula, if the number of the printing chips 1 is made [many] not much, the load at the time of a print head moving will become large, and troublesome various problems, such as degradation of a quality of printed character, strengthening of a frame, and enlargement of equipment, will occur. Therefore, the printer of a line formula benefits improvement in the speed the lead in future development.

[0022] Drawing 7 is drawing showing typically the composition of the color print head of such a line formula printer. As shown in this drawing, the color print head 15 extends in the main scanning direction shown by the both-directions arrow x of drawing, and they are a total of 12 drawing 6 (a). On the parent substrate 16, the shown printing chip 1 is alternately arranged in the shape of an alternate pattern (staggered arrangement), and forms the printing area of length B at main scanning direction.

[0023] Thus, shifting the printing chip 1 alternately and arranging by the staggered arrangement Even if it is because there is a marginal part 9 (refer to drawing 6 (a)) and carries out adhesion arrangement of the printing chip 1 at the shape of a straight line It is because the nozzle train 2 of each printing chip 1 does not continue at the right interval since only the double precision of a marginal part 9 will separate distance and the ink regurgitation nozzle 14 of each edge of the nozzle train 2 of the adjoining printing chip 1 and the nozzle train 2 will exist.

[0024] Drawing 8 (a) It is drawing showing the composition of the ink supply way by the side of the parent substrate which supplies ink to the printing chip 1 arranged as mentioned above at the parent substrate 16, and is this drawing (b). This drawing (a) It is a C-C' cross-section expansion view view. Moreover, this drawing (c) The printing chip 1 is re-*(ed), and is shown and it is this drawing (d). It is the D-D' cross-section expansion view view. This drawing (a) The parent substrate 16 before arranging the printing chip 1 is shown, and dashed line 1' shows the position which should arrange the printing chip 1.

[0025] This drawing (a) The ink tank 17 (17-1, 17-2) is arranged in the both ends of the printing area in which the printing chip 1 is arranged by the parent substrate 16 so that it may be shown.

And each ink tank 17 is equipped with the ink reservoir of four rooms which contains the ink of yellow (Y), a Magenta (M), cyanogen (C), and black (K), and eight ink supply ways 18 which are open for free passage to these are formed on the parent substrate 16. Among eight ink supply ways 18, four ink supply ways 18 are open for free passage to each ink reservoir of one ink tank 17-1, respectively, and other four ink supply ways 18 are opening them for free passage, respectively to each ink reservoir of the ink tank 17-2 of another side.

[0026] and drawing 8 (a) six printing chips 1 located in a line with width 1 train up so that it may be shown — (drawing 7 — reference) — respectively — drawing 8 (d) And this drawing (b) As the dashed line arrow E of a between shows the connection which has been arranged on four ink supply ways 18 which begin to be extended from one ink tank 17-1, and was formed in the non-illustrated adhesion sealing material — a hole — minding — ink receipt of printing chip 1 rear face — a hole 6 and the ink supply way 18 of the parent substrate 16 are open for free passage moreover, the connection to which six printing chips 1 similarly caudad located in a line with width 1 train have been arranged on four ink supply ways 18 which begin to be extended from the ink tank 17-2 of another side, and were similarly formed in the non-illustrated adhesion sealing material — a hole — minding — ink receipt of printing chip 1 rear face — a hole 6 and the ink supply way 18 of the parent substrate 16 are open for free passage

[0027] Thereby, it is this drawing (c). The yellow of the shown printing chip 1, a Magenta, the ink supply slot 5 (drawing 6 (c) —) shown in this drawing (c) currently formed in parallel with the nozzle train of four trains corresponding to cyanogen and black regurgitation ink with a two-dot chain line in transillumination (d) the ink of the color respectively corresponding to reference — the ink supply way 18 and ink receipt — it is supplied from the ink tank 17-1 or 17-2 through a hole 6

[0028] drawing 9 — the ink supply way 18 of the above-mentioned parent substrate 16, and ink receipt of the printing chip 1 — it is drawing expanding and showing the relation of an arrangement position with a hole 6 This drawing shows the printing chip 1 and nozzle train 14' with the dashed line in order to show only an important section intelligibly. it is shown in this drawing — as — three ink receipt of each printing chip 1 which corresponds for every train of nozzle train 14' of four trains, respectively — ***** by which a hole 6 is arranged on the ink supply way 18 of the color ink corresponding to these

[0029]

[Problem(s) to be Solved by the Invention] However, between each printing chip 1 located in a line with one train at main scanning direction (longitudinal direction of drawing 9), and the printing chip 1, the useless big space G is made of arrangement of the printing chip 1 which carried out the staggered arrangement, the composition 16, i.e., the parent substrate, of the color print head 15 mentioned above. And in order to bury this printing blank section, it is the arrangement which shifted the adjoining printing chip 1 to a top or the bottom, and carried out the staggered arrangement of the printing chip 1 of two trains to main scanning direction as a whole. Consequently, it has the first fault that the width of face of the direction of vertical scanning of the color print head 15 will become large. Moreover, as shown in this drawing, no less than eight ink supply ways 18 were required, and now, it assembled and had the 2nd fault the trouble at the time and the time of maintenance not only starts, but that two ink tanks 17 were also needed and cost increased.

[0030] The technical problem of this invention is having minimum number of ink supply ways, and there being no useless space in view of the above-mentioned conventional actual condition, and offering a multi-array formula ink-jet print head with the narrower width of face of the direction of a short hand.

[0031]

[Means for Solving the Problem] The multi-array formula ink-jet print head of this invention arranges two or more sub heads which arrange two or more printing chips which have arranged two or more ink regurgitation nozzles in the shape of a straight line with the predetermined angle theta (however, $\theta \neq 0$) to the predetermined direction, and change, and these sub heads in the right-angled direction to the above-mentioned predetermined direction, and is constituted.

[0032] Like for example, claim 2 publication, the above-mentioned predetermined direction is the

main scanning direction of printing, and like for example, claim 3 publication, it is constituted so that it may become the direction of vertical scanning of printing. Moreover, the above-mentioned predetermined angle theta has [like] a desirable thing [that they are 5 times or more and 45 degrees or less] according to claim 4, for example.

[0033] Moreover, two or more above-mentioned printing chips arranged at the one above-mentioned sub head share exclusive use and a single ink supply way like for example, claim 5 publication, and are constituted. Moreover, the above-mentioned ink regurgitation nozzle consists of the 2nd train according to claim 6 which only the predetermined distance a shifted to the longitudinal direction of the 1st train and this 1st train within the above-mentioned printing chip, and only the predetermined distance b left in the direction of a short hand of the 1st train of the above like, for example.

[0034] and — for example, — being according to claim 7 — with the distance f of a right-angled direction like in the above-mentioned predetermined direction between the ink regurgitation nozzle of the toe of the 1st train of the above in the above-mentioned printing chip, and the ink regurgitation nozzle of the toe of the 2nd train of the above As for the distance g of a direction right-angled in the above-mentioned predetermined direction between the ink regurgitation nozzles of the heel of the 1st train of the above of the printing chip which adjoins in the above-mentioned predetermined direction of the ink regurgitation nozzle of the heel of the 2nd train of the above, and this printing chip, it is desirable to constitute so that it may become a repeat range "f=g."

[0035] moreover, the above-mentioned ink regurgitation nozzle — for example, — being according to claim 8 — like — the inside of the above-mentioned printing chip — the 1st vertical 4 train — this — you may make it constitute from the 2nd vertical 4 train which only the predetermined distance j shifted to the longitudinal direction of the 1st vertical 4 train, and only the predetermined distance k left in the direction of a short hand of vertical 4 train of the above 1st

[0036]

[Embodiments of the Invention] Hereafter, the gestalt of operation of this invention is explained, referring to a drawing. Drawing 1 (a) It is the printing chip plot plan of the multi-array formula ink-jet print head in the gestalt of the 1st operation, and is this drawing (b). The enlarged view and this drawing (c) It is drawing expanding and showing the part further.

[0037] This drawing (a) The shown print head 20 is an ink-jet print head for full color of a multi-array formula, and much printing chips 22 lean to the parent substrate 21, and are arranged. In addition, this drawing (a) In the shown example, the printing chip 22 is a printing chip with which the nozzle train 26 consists only of one train. Moreover, although a total of 52 printing chips 22 is arranged to the parent substrate 21, the number of arrangement of the printing chip 22 is not necessarily restricted with 52 pieces, and is good by arbitrary numbers according to the plan of a design.

[0038] This drawing (a) In the shown print head 20 The direction where one sub head 23 (23-1, 23-2, 23-3, or 23-4) constituted by 13 printing chips 22 which inclined to the main scanning direction shown by the both-directions arrow H aslant, and have been arranged is as right-angled as the above-mentioned main scanning direction, That is, it is arranged together with [plurality (at the example shown in this drawing (a), it is four)] the direction of vertical scanning.

[0039] Since each printing chip 22 inclines aslant and is complex, four sub heads 23-1 to 23-4 are not necessarily formed independently, and these sub heads 23 become intricate mutually partially, are formed, and constitute the print head 20 as a whole. The degrees theta of angle of inclination of each above-mentioned printing chip 22 are 5 times or more and 45 degrees or less to main scanning direction.

[0040] Thus, since it inclines aslant, and each printing chip 22 of four sub heads 23 becomes intricate and is arranged, it is narrower than the width of face F of the direction of vertical scanning of the big color print head 15 of the former which there is no useless gap by getting it blocked, and the width of face J of the direction of vertical scanning of a print head 20 showed to drawing 7 only in the part (refer to drawing 9) between each printing chip 22 which adjoins

vertically and horizontally.

[0041] And in this parent substrate 21, it is this drawing (b). So that it may be shown Yellow of one non-illustrated ink tank, Four ink supply ways 24 (24-1, 24-2, 24-3, 24-4) which are open for free passage, respectively are formed in Macenta, cyanogen, and four black ink reservoir rooms. In the adhesion sealing material infixed between the printing chips 22 arranged on these ink supply way 24 two or more ink receipt of the ink supply way 24 and each printing chip 22 — the long and slender ink free passage corresponding to a hole (three ink receipt for every nozzle train shown in drawing 8 (c), (d), and drawing 9 — formed like the hole 6) — the hole 25 is formed

[0042] Thus, each sub head 23 consists of one ink supply way 24 corresponding to the ink of one color, and 13 printing chips 22 which leaned aslant and were arranged on this, respectively, and the ink supply way 24 consists of only four as the print head 20 whole.

[0043] To main scanning direction, two or more (this example 13) every above-mentioned sub head 23 by this a certain printing chip 22 It is constituted so that exclusive use and the single ink supply way 24 (24-1, 24-2, 24-3, or 24-4) may be shared. Each printing chip 22 of the sub head 23-1 For example, yellow (Y) ink, In each printing chip 22 of Magenta (M) ink and the sub head 23-3, each printing chip 22 of cyanogen (C) ink and the sub head 23-4 corresponds [each printing chip 22 of the sub head 23-2] to black (K) ink.

[0044] Moreover, it sets to the arrangement of the printing chip 22 which inclined aslant [above-mentioned], and is this drawing (c). So that it may be shown printing chip 22-i ($i = 1, 2, \text{ and } \dots$) which adjoins within the same sub head The pitch P2 of the main scanning direction between 13), ink regurgitation nozzle 27-n (the number of ink regurgitation nozzle configurations within the n: nozzle train 26) of the edge where each nozzle train 26 and 26 of 22-i+1 approaches mutually, and 27-1 It is the same as that of the pitch P1 between ink regurgitation nozzle 27j within the nozzle train 26 ($j = 1, 2, \dots, n$).

[0045] Moreover, while adjoins between the adjoining sub heads and the gap L of the direction of vertical scanning between printing chip 22-i of a sub head, ink **** NOZUSU 27-n of the edge where each nozzle train 26 and 26 of the printing chip 22-i+1 of the sub head of another side approaches mutually, and 27-1 corresponds to the distance between the ink of a different color breathed out by the ink **** nozzle 27. as for this distance (gap L), it be desirable to be referred to as 0.5mm or more, and it be elaborate — be alike — in case wiping of the ink **** nozzle 27 (that is, nozzle train 26) is carried out to main scanning direction with the wiper which is not illustrated [RI and], the color mixture of ink can be prevented

[0046] Drawing 2 is drawing showing the modification in the gestalt of implementation of the above 1st. The print head 30 shown in this drawing leans long 4 color chip 32 to the parent substrate 31 aslant a little, and are arranged. [two or more (the example of this drawing ten pieces)] The nozzle train 33 turns into one train, and is arranged in the longitudinal direction by four trains of four color each chips 32. The nozzle train 33 of these 4 train carries out the regurgitation of yellow (Y) ink, Magenta (M) ink, cyanogen (C) ink, and the black (K) ink, respectively. Moreover, although not illustrated especially, four ink supply ways which supply the ink of the color corresponding to these nozzle trains 33 are formed on the parent substrate 31.

[0047] if only the composition of the nozzle train 33 of the interior divided with the dashed line 28 and dashed line 29 which are shown in this drawing is seen — these nozzle train arrangement composition — drawing 1 (a) and (b) It turns out that it is the same as that of the shown nozzle train arrangement composition of the print head 20 in the gestalt of the 1st operation. thus, even if constituted, the number of the printing chips which the same effect as the print head 20 of drawing 1 is acquired, and are carried in the parent substrate 31 can be made to decrease to about 1/4 by simple calculation as compared with the print head 20 of drawing 1

[0048] drawing 3 (a) the plan of the outline of the printing chip concerning the gestalt of the 2nd operation — it is — this drawing (b) Drawing and this drawing (c) showing the print head which arranged the printing chip the ink supply way of the parent substrate, and the free passage of an adhesion sealing material — drawing and this drawing (d) showing arrangement and the configuration of a hole — this drawing (b) It is an enlarged view a part.

[0049] This drawing (a) This printing chip 35 is equipped with the nozzle train 36 (36-1, 36-2) of

two trains which consist of many ink regurgitation nozzles 34 so that it may be shown. These nozzle train 36 consists of nozzle trains 36-2 as the 2nd train which only the predetermined distance a shifted to the longitudinal direction of the nozzle train 36-1 as the 1st train, and this nozzle train 36-1, and only the predetermined distance b left in the direction of a short hand of the nozzle train 36-1.

[0050] Such a printing chip 35 is arranged by the parent substrate 37 in the state where it inclined to the main scanning direction shown by the both-directions arrow M of drawing also in this case aslant. And one sub head 38 (38-1, 38-2, 38-3, or 38-4) formed by two or more printing chips 35 on a par with the main scanning direction constitutes the print head 40 from 4 ***** in the direction of vertical scanning. Also in this case, the degrees delta of angle of inclination of the printing chip 35 are 5 times or more and 45 degrees or less to main scanning direction.

[0051] Since the printing chip 35 of each sub head 38 inclines aslant and is complex also in this case, there is no big gap between each printing chip 35 which adjoins vertically and horizontally, and the width of face N of the direction of vertical scanning of a print head 40 is narrower than the width of face F of the direction of vertical scanning of the conventional color print head 15 which only the part showed to drawing 7 (refer to drawing 9).

[0052] and — this parent substrate 37 — this drawing (c) it is shown — as — the yellow (Y) of one non-illustrated ink tank, and Macenta — four ink supply ways 41 (41-1, 41-2, 41-3, 41-4) which are open for free passage, respectively are formed in (M), cyanogen (C), and four black (K) ink reservoir rooms

[0053] In the adhesion sealing material infixed between the printing chips 35 arranged on these ink supply way 41 the both ends of the ink supply way 41 — ink receipt of the nozzle train 36-1 of the printing chip 35-1 of one edge — the long and slender a little short ink free passage corresponding to a hole — a hole — 42a and the other-end section printing chip 35 — 42B is Formed. Ink Receipt of Nozzle Train 36-2 of K (the Number of Printing Chips Arranged by K:1 Sub Head 38) — Long and Slender a Little Short Ink Free Passage corresponding to Hole — Hole — the ink free passage extended long and slender with the level difference shared between middle portions other than both ends with the nozzle train 36-1 of printing chip 35-q (2 q= three ..., k), and the nozzle train 36-2 of the printing chip 35-q-1 — the hole 43 is formed

[0054] Thus, each sub head 38 consists of one ink supply way 41 corresponding to the ink of one color, and k printing chips 35 which leaned aslant and were arranged on this, respectively, and consists of four ink supply ways 41-1 to 41-4 also in this case as the print head 40 whole.

[0055] To main scanning direction, two or more (k pieces) every above-mentioned sub head 38 and a certain printing chip 35 It is constituted so that exclusive use and the single ink supply way 41 may be shared, for example, it is this drawing (c). So that it may be shown Each printing chip 35 of the sub head 38-1 each printing chip 35 of yellow (Y) ink and the sub head 38-2 Magenta (M) ink, In each printing chip 35 of the sub head 38-3, each printing chip 35 of cyanogen (C) ink and the sub head 38-4 corresponds to black (K) ink.

[0056] Thus, even if constituted, it is this drawing 3 (b). Above-mentioned drawing 1 (a) It compares, and arrangement of each nozzle train in a parent substrate is the same so that it may understand. Moreover, it sets to the arrangement of the printing chip 35 which inclined aslant [above-mentioned], and is this drawing (d). So that it may be shown Each nozzle train 36-2 of the printing chips 35 and 35 which adjoin within the same sub head, and 36-1, The pitch d3 of the main scanning direction between ink regurgitation nozzle 34-m (the number of ink regurgitation nozzle configurations within the m: nozzle train 36) of the edge which approaches mutually, and 34-1, the same nozzle train 36 (as an example) This drawing (d) The pitch d2 of the main scanning direction between the ink regurgitation nozzles 34-1 of the toe of ink regurgitation nozzle 34-m of the toe of the pitch d1 between ink regurgitation nozzle 34 within the nozzle train 36-1, and the nozzle train 36-1 in the same printing chip 35, and the nozzle train 36-2 It is constituted so that it may become the same [all].

[0057] Moreover, the ink regurgitation nozzle 34-1 of the heel of the nozzle train 36-1 of each printing chip 35 located in a line in the same sub head and the ink regurgitation nozzle 34-1 of the toe of the nozzle train 36-2 make a straight line to main scanning direction, and are arranged

at it. Similarly, ink regurgitation nozzle 34-m of the toe of the nozzle train 36-1 of each printing chip 35 and ink regurgitation nozzle 34-m of the heel of the nozzle train 36-2 also make a straight line to main scanning direction, and are arranged at it.

[0058] Also in which sub head 38, it is desirable to set distance e of the nozzle train 36-1 of the printing chip 35, the nozzle train 36-1 of the printing chip 35 of the ink **** nozzle 34-1 of each edge of 36-2 and the adjoining sub head 38, and the direction of vertical scanning with ink **** nozzle 34-m of each edge of 36-2 to 0.5mm or more. This distance e is equivalent to the distance between the ink in which the colors of the ink breathed out by the nozzle train 36-1 of each sub head 38 and 36-2 differ, and by setting this distance e to 0.5mm or more, in case wiping of the sub head is carried out to main scanning direction with a non-illustrated wiper, the color mixture of ink can be prevented.

[0059] Drawing 4 (a) Desirable arrangement is shown in inclination arrangement of the printing chip 35 in the same above-mentioned sub head, and it is this drawing (b). Although you may arrange in this way, the arrangement which cannot say that it is desirable is shown. Namely, this drawing (a) The shown printing chip arrangement The distance f of the direction of vertical scanning between the ink regurgitation nozzles 34-1 of the heel of the nozzle train 36-1 of the printing chip 35-q+1 of ink regurgitation nozzle 34-m of the heel of the nozzle train 36-2 of printing chip 35-q, and contiguity It is arranged so that it may become the same distance "f=g" as the distance g of the direction of vertical scanning between the ink regurgitation nozzles 34-1 of the toe of ink regurgitation nozzle 34-m of the toe of the nozzle train 36-1 of the same printing chip 35 (for example, printing chip 35-q+1 of this drawing (a)), and the nozzle train 36-2. Thus, if it arranges, since all the physical relationship of the direction of vertical scanning of nozzle **** in the same sub head which consists of a nozzle train 36-1 of each printing chip 35 and 36-2 will become the same, the circuit of a printing control section or the composition of a program can be simplified more.

[0060] On the other hand, this drawing (b) It becomes [control of the regurgitation timing for every nozzle train] complicated that it is the arrangement from which distance f' between the nozzle trains in the same printing chip and distance g' between the nozzle trains of a contiguity printing chip differ and is troublesome so that it may be shown.

[0061] Drawing 5 (a) and (b) It is drawing showing the modification in the gestalt of implementation of the above 2nd. This drawing (a) The shown print head 45 leans long 4 color printing chip 47 to the parent substrate 46 aslant, and are arranged. [two or more (the example of this drawing ten pieces)]

[0062] This drawing (b) So that it may be shown 4 color printing chip 47 Nozzle train 49-1a of four trains in which the ink regurgitation nozzle 48 forms the 1st vertical 4 train within 4 color printing chip 47, 49-1b, 49-1c, and 49 to 1 d, Nozzle train 49-2a of four trains which are the 2nd vertical 4 train which only the predetermined distance j shifted to the longitudinal direction of the 1st vertical 4 train, and only the predetermined distance k left in the direction of a short hand of the 1st vertical 4 train, 49-2b, 49-2c, and 49 to 2 d are formed.

[0063] Also in this case, it is this drawing (a). It is drawing 3 (b) so that it may turn out that only arrangement of the 49 to 1 d nozzle train of the interior divided with the dashed line 51 and dashed line 52 which are shown, 49 to 2 d, etc. is seen. Or drawing 1 (a) Arrangement of the shown composition and each nozzle train in the parent substrate 46 is the same. That is, also of this, the width of face of the direction of vertical scanning is narrow, and four print heads 45 are formed for an ink supply way.

[0064] In addition, although the form of operation mentioned above explains as a print head for line printers which all makes the longitudinal direction of a print head the main scanning direction of printing, it is natural [the print head of this invention] that it is applicable to the print head for serial printers by making the longitudinal direction of a print head into the direction of vertical scanning, without restricting to this.

[0065]

[Effect of the Invention] Since according to this invention the printing chip which has the nozzle train of at least 1 train is leaned the degree of predetermined angle and more than one are arranged in a parent substrate as explained to the detail above The useless space during a

printing chip can be lessened as much as possible. by this While the composition of the ink supply way of only the color number of ink may be used, and it becomes, while being able to make width of face of the direction of a short hand of a print head smaller than before, therefore being able to miniaturize the main part of a printer more It becomes possible for the trouble at the time of an assembly and maintenance not to start, but to offer a low cost multi-array formula ink-jet print head.

[Translation done.]

*** NOTICES ***

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] (a) The printing chip plot plan of the multi-array formula ink-jet print head in the operation gestalt of **** 1, and (b) The enlarged view and (c) It is drawing expanding and showing a part [further].

[Drawing 2] It is drawing showing the modification in the gestalt of the 1st operation.

[Drawing 3] (a) the plan of the outline of the printing chip concerning the operation gestalt of **** 2, and (b) Drawing showing the print head which arranged the printing chip, and (c) the ink supply way of the parent substrate, and the free passage of an adhesion sealing material — drawing showing arrangement and the configuration of a hole, and (d) (b) It is an enlarged view a part.

[Drawing 4] (a) Drawing and (b) which show the desirable inclination arrangement in the same sub head of the printing chip concerning the operation gestalt of **** 2 It is drawing showing the arrangement which cannot say that it is not much desirable.

[Drawing 5] (a) and (b) It is drawing showing the modification in the 2nd operation gestalt.

[Drawing 6] (a) The plan and (b) which show the ink regurgitation side of the printing chip of ***** The rear view and (c) (a) The enlarged view and (d) which show the interior of the portion enclosed with the alternate long and short dash line a (c) It is an A-A' cross-section view view.

[Drawing 7] It is drawing showing typically the composition of the color print head of the conventional line formula printer.

[Drawing 8] (a) Drawing and (b) which show the composition of the ink supply way which supplies ink to the printing chip arranged at the parent substrate of the color print head of ***** (a) A C-C' cross-section expansion view view and (c) Drawing and (d) which show a printing chip It is the D-D' cross-section expansion view view.

[Drawing 9] ink receipt of the ink supply way of the parent substrate of the conventional color print head, and a printing chip — it is drawing expanding and showing the relation of an arrangement position with a hole

[Description of Notations]

- 1 Printing Chip
- 2 Nozzle Train
- 3 Silicon Chip Substrate
- 4 Drive Circuit
- 4-1 Electrode Terminal
- 5 Ink Supply Slot
- 6 Ink Receipt — Hole
- 7 Heater Element
- 8 Wiring Electrode
- 8a Common electrode
- 8b Individual wiring electrode
- 9 Marginal Part
- 10 Electrode Terminal for Connection

11 Septum
11-1 Protrusion Section
12 Ink Pressurized Room
13 Orifice Plate
14 Ink Regurgitation Nozzle
14' Nozzle train
15 Color Print Head
16 Parent Substrate
17 (17-1, 17-2) Ink tank
18 Ink Supply Way
20 Print Head
21 Parent Substrate
22 and 22-i (i= 1, 2, ..., 13) Printing chip
23 (23-1, 23-2, 23-3, 23-4) Sub head
24 (24-1, 24-2, 24-3, 24-4) Ink supply way
25 Ink Run Through-hole
26 Nozzle Train
27-j (j= 1, 2, ..., n) Ink regurgitation nozzle
30 Print Head
31 Parent Substrate
32 4 Color Chip
33 Nozzle Train
34, 34-1, 34-m Ink regurgitation nozzle
35, 35-1, 35-k, 35-q (2 q= three ..., k) Printing chip
36 (36-1, 36-2) Nozzle train
37 Parent Substrate
38 (38-1, 38-2, 38-3, 38-4) Sub head
40 Print Head
41 (41-1, 41-2, 41-3, 41-4) Ink supply way
42a, 42b, 43 Ink run through-hole
45 Print Head
46 Parent Substrate
47 4 Color Printing Chip
48 Ink Regurgitation Nozzle
49 Nozzle Train

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Diagram (c) illustrates a cross-section of a multi-layered structure. The structure consists of several layers and interfaces, labeled as follows:

- 27-n**: The topmost layer.
- P2**: An interface or boundary between layers.
- 22-i**: A layer below P2.
- 22-i+1**: A layer below 22-i.
- 26**: A layer below 22-i+1.
- 27-i**: A layer below 26.
- 27-i+1**: A layer below 27-i.
- 26**: A layer below 27-i+1.
- 27-n**: A layer below 26.
- 22-i**: A layer below 27-n.

 The diagram shows the spatial arrangement and relative positions of these layers and interfaces.

【特許請求の範囲】

【請求項1】 複数のインク吐出ノズルを直線状に配置した印字チップを所定方向に対して所定の角度 θ （但し、 $\theta \neq 0$ ）をもつて複数配置して成るサブヘッドと、該サブヘッドを前記所定方向に対して直角方向に複数配置して成るマルチアレイ式インクジェット印字ヘッド。

【請求項2】 前記所定方向は、印字の主走査方向であることを特徴とする請求項1記載のマルチアレイ式インクジェット印字ヘッド。

【請求項3】 前記所定方向は、印字の副走査方向であることを特徴とする請求項1記載のマルチアレイ式インクジェット印字ヘッド。

【請求項4】 前記所定の角度 θ は、5度以上、45度以下であることを特徴とする請求項1記載のマルチアレイ式インクジェット印字ヘッド。

【請求項5】 一つの前記サブヘッドに配置された複数の前記印字チップは、専用且つ単一のインク供給路を共有することを特徴とする請求項1、2、3又は4記載のマルチアレイ式インクジェット印字ヘッド。

【請求項6】 前記インク吐出ノズルは、前記印字チップ内で第1の列と該第1の列の長手方向に所定距離 a だけずれ且つ前記第1の列の短手方向に所定距離 b だけ離れた第2の列とで構成されることを特徴とする請求項1、2、3、4又は5記載のマルチアレイ式インクジェット印字ヘッド。

【請求項7】 前記印字チップ内の前記第1の列の内端部のインク吐出ノズルと前記第2の列の内端部のインク吐出ノズル間の前記所定方向に直角な方向の距離 f と、前記第2の列の外端部のインク吐出ノズルと該印字チップの前記所定方向に隣接する印字チップの前記第1の列の外端部のインク吐出ノズル間の前記所定方向に直角な方向の距離 g とは、同一距離「 $f = g$ 」であることを特徴とする請求項6記載のマルチアレイ式インクジェット印字ヘッド。

【請求項8】 前記インク吐出ノズルは、前記印字チップ内で第1の縦4列と該第1の縦4列の長手方向に所定距離 j だけずれ且つ前記第1の縦4列の短手方向に所定距離 k だけ離れた第2の縦4列とで構成されることを特徴とする請求項1記載のマルチアレイ式インクジェット印字ヘッド。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、親基板の長手方向に形成されるインク供給路が各色毎に1本のみから成るマルチアレイ式インクジェット印字ヘッドに関する。

【0002】

【従来の技術】 従来より、インクボットのインクを用紙面に吐出して印字を行うインクジェットプリンタがある。インクジェットプリンタは、300dpi（ドット／インチ）又はそれ以上の微細な解像度で形成された多

数の印字素子を備えた印字ヘッドによって印字情報に応じた文字や画像を記録（印字、印刷）する。

【0003】 インクジェットプリンタによる記録方法は、チップ状の小基板（以下、印字チップという）のインク吐出面に多数配列されている微細なノズルからインクの液滴を吐出させ、このインク滴（印字ドット）を紙、布などの被記録材に吐出・着弾させて吸収させ、これにより文字や画像等の記録を行なうものであり、騒音の発生が少なく、特別な定着処理を要することもなく且つフルカラー記録も比較的容易な記録方法である。

【0004】 フルカラー記録は、通常、減法混色の三原色であるイエロー（黄色）、マゼンタ（赤色染料名）及びシアン（緑味のある青色）の3色のインクを用い、或は文字や画像の黒色部分などに用いられる黒を加えた4色のインクを用いて行われる。

【0005】 インクの液滴を吐出させる方法としては、ピエゾ抵抗素子（圧電素子）などの電気機械変換素子を用いてインクチャンバーに機械的変形による圧力を生じさせ、これにより微小ノズルから液滴を吐出させるピエゾジェット方式や、微細なインク室に発熱素子を配して、これに電気パルスを与え高速でインクと発熱素子の界面に気泡を発生させ、その気泡の成長力を利用して同様に微小ノズルから液滴を吐出させるサーマルジェット方式などがある。

【0006】 また、上記のサーマルジェット方式には、インク滴の吐出方向により、二通りの構成がある。一つは発熱素子の発熱面に平行な方向へインクを吐出する構成のサイドシュータ型であり、他の一つは発熱素子の発熱面に垂直な方向にインクを吐出するルーフシュータ型である。

【0007】 このようなルーフシュータ型のサーマルインクジェットプリンタに用いられる印字チップの製法として、シリコンLSI形成処理技術と薄膜形成技術を利用して、複数の発熱素子とこれらを個々に駆動する駆動回路とインク供給路とインク吐出ノズルとを、一枚のシリコンチップ基板上にモノリシックに形成する方法がある。

【0008】 この方法によれば、例えば10mm×15mmのシリコンチップ基板上に解像度が360dpi（ドット／インチ）の印字チップを作成する場合は、128個の発熱素子と駆動回路とインク吐出ノズルを形成することができる。

【0009】 図6(a)は、そのような印字チップのインク吐出面を示す平面図であり、同図(b)は、その背面図である。また、同図(c)は、同図(a)の一点鎖線aで四角く囲んだ部分のオリフィス板を取り除いて内部を示す拡大図であり、同図(d)は、同図(c)のA-A'断面矢視図である。

【0010】 同図(a)に示す印字チップ1は、1つのシリコンチップ基板3上にノズル列2を4列備えている。

これら4列のノズル列2は、それぞれイエローインク(Y)、マゼンタインク(M)、シアンインク(C)又は黒(K)のインクを吐出するように構成されている。

【0011】同図(a)～(d)に示すように、印字チップ1は、シリコンチップ基板3の上面に駆動回路4がLSI形成処理技術により形成され、インク供給溝5が例えば湿式エッチングにより穿設され、このインク供給溝5に連通しシリコンチップ基板3の裏面に開口するインク受給孔6がシリコンチップ基板3を貫通している。

【0012】上記の駆動回路4とインク供給溝5の間にはフォトリソグラフィ技術等による薄膜形成技術により、発熱素子7が例えば64個、128個、又は256個等多数形成されて、更にこれらの発熱素子7に、配線電極8として共通電極8aと個別配線電極8bとが接続され、その個別配線電極8bに駆動回路4の電極端子4-1が接続され、シリコンチップ基板3表面の上下の縁部9に外部との接続用電極端子10が夫々形成されている。

【0013】そして、これらの上には、上記の接続用電極端子10部分を除く全面に、隔壁11が積層されている。隔壁11は、一方でインク供給溝5の左方でインクを外部から遮断するインクシール壁を形成し、他方では個別配線電極8b及び駆動回路4上で同じくインクを外部から遮断するインクシール壁を形成し、更にこの個別配線電極8b部分の隔壁11は、各発熱素子7と発熱素子7の間に伸び出す突設部11-1を備えている。隔壁11の上記個別配線電極8b及び駆動回路4上の部分を櫛の胴とすれば、これから各発熱素子7間に伸び出す突設部11-1は櫛の歯に相当する形状をなしている。これにより、この櫛の歯を仕切り壁として、その歯と歯の間の付け根部分に発熱素子7が位置する微細なインク加圧室12が発熱素子7の数だけ区画・形成されている。

【0014】更にこれらの駆動回路4、発熱素子7、共通電極8a、個別配線電極8b及び隔壁11の形成されたシリコンチップ基板3の最上層にオリフィス板13が積層され、そのオリフィス板13の上記発熱素子7に対向する位置に、多数のインク吐出ノズル14が穿設されて、上述した4列のノズル列2を形成している。4列のノズル列2は、互いに平行して形成され、端部のインク吐出ノズル14が相互に同一高さに揃えて形成されている。つまり、4列のノズル列2は相互に上下のズレの無いように形成されている。

【0015】このような印字チップ1の解像度、すなわちインク吐出ノズル14の配設ピッチは、現今では極めて一般的なもので300dpi(ドット/インチ)、高解像度のものでは600dpiが普通である。600dpiをミリ換算で見ると1mm当り約24個の発熱素子7及びインク吐出ノズル14から成る印字素子が一列に並ぶことになり、そのピッチは約42μmである。

【0016】このような形状で、不図示のシリコンウエ

ハ上の多数のシリコンチップ基板3上に印字チップ1が完成する。そして、最後に、ダイシングソーなどを用いてカッティングして、チップ基板単位毎に個別に分割し、実装基板にダイスボンディングし、端子接続して、実用単位の印字チップとなる。

【0017】この印字チップ1は、外部からインク受給孔6へ供給されるインクがインク供給溝5を介してインク加圧室12に供給され、印字に際しては発熱素子7が印字情報に応じて選択的に通電され、瞬時に発熱してインクに膜沸騰現象を発生させ、その核気泡の圧力により、発熱素子7に対応するインク吐出ノズル14からインク滴が吐出される。

【0018】一般に、プリンタは、構成上の分類としてシリアル式とライン式に分類できる。シリアル式では、その印字ヘッドとして従来は上記の印字チップ1が単体で用いられることが多かったが、近年では印字チップ1を印字の副走査方向に複数個配置して長尺化した印字ヘッドが実用化されつつある。小さな印字チップ1を複数個配置して長尺化する理由は、印字チップ1の加工技術(主として加工装置)に様々な限界があるために、長尺で単体の印字チップを作ることができないからである。

【0019】上記のシリアル式のプリンタは、配設される印字チップ1の多いか少ないかでプリンタの印字速度が左右される。勿論、ノズル列の長手方向に配置した印字チップ1の数が多いほうが一度の主走査で印字する副走査方向の幅(縦幅)が広がるから印字処理は高速となる。一方、ライン式のプリンタは、主走査方向の印字領域一杯に印字チップ1を配列して長尺化した印字ヘッドを用い、その印字ヘッドをプリンタ本体側に固定して用紙のみを搬送する方式であり、その方式自体が高速性に対応しており、また、機械的な負荷も小さくて消費電力が少なく経済的である。

【0020】したがって、近年のように印字処理の速度を、より高速にしたい、という要望に応えるためには、シリアル式のプリンタの場合は主走査1ラインの印字で出来るだけ縦幅の長い印字を行うために、複数の印字チップを副走査方向に継いで副走査方向に長い印字ヘッドを形成する必要がある、また、ライン式のプリンタの場合は複数の印字チップを主走査方向に継いで印字ヘッドを形成することは初めから必須の作業となっている。

【0021】とはいっても、シリアル式のプリンタでは、あまり印字チップ1の数を多くすると、印字ヘッドが移動する際の負荷が大きくなって印字品質の劣化、フレームの強化、装置の大型化など厄介な種々の問題が発生する。したがって、高速化のためにはライン式のプリンタが今後の開発の中心となってくる。

【0022】図7は、そのようなライン式プリンタのカラー印字ヘッドの構成を模式的に示す図である。同図に示すように、カラー印字ヘッド15は、図の両方向矢印xで示す主走査方向に延在して合計12個の図6(a)に

示した印字チップ1が親基板16上に互い違いに千鳥模様状に配置(千鳥配列)されて、主走査方向に長さBの印字領域を形成している。

【0023】このように、印字チップ1を互い違いにずらして千鳥配列で配置するのは、縁部9があるからであり(図6(a)参照)、印字チップ1をたとえ直線状に密着配置しても、隣接する印字チップ1のノズル列2とノズル列2の夫々の端部のインク吐出ノズル14が、縁部9の2倍だけ距離を隔てて存在することになるため、各印字チップ1のノズル列2が正しい間隔で連続しないからである。

【0024】図8(a)は、上記のように親基板16に配置される印字チップ1へインクを供給する親基板側のインク供給路の構成を示す図であり、同図(b)は同図(a)のC-C'断面拡大矢視図である。また、同図(c)は、印字チップ1を再掲して示し、同図(d)はそのD-D'断面拡大矢視図である。同図(a)は印字チップ1を配設する前の親基板16を示しており、印字チップ1を配設すべき位置を破線1'で示している。

【0025】同図(a)に示すように、親基板16には、印字チップ1が配設される印字領域の両端部にインクタンク17(17-1、17-2)が配設されている。そして、各インクタンク17は、イエロー(Y)、マゼンタ(M)、シアン(C)及び黒(K)のインクを収納する4室のインク貯溜室を備え、これらに連通する8本のインク供給路18が親基板16上に形成されている。8本のインク供給路18のうち4本のインク供給路18は、一方のインクタンク17-1の各インク貯溜室に夫々連通し、他の4本のインク供給路18は他方のインクタンク17-2の各インク貯溜室に夫々連通している。

【0026】そして、図8(a)に示すように上方に横1列に並ぶ6個の印字チップ1が(図7を参照)、夫々図8(d)及び同図(b)間の破線矢印Eで示すように、一方のインクタンク17-1から伸び出す4本のインク供給路18上に配置され、不図示の接着シーリング材に形成された接続孔を介して印字チップ1裏面のインク受給孔6と親基板16のインク供給路18とが連通する。また、同じく下方に横1列に並ぶ6個の印字チップ1が他方のインクタンク17-2から伸び出す4本のインク供給路18上に配置され、同様に不図示の接着シーリング材に形成された接続孔を介して印字チップ1裏面のインク受給孔6と親基板16のインク供給路18とが連通する。

【0027】これにより、同図(c)に示す印字チップ1のイエロー、マゼンタ、シアン及び黒の吐出インクに対応する4列のノズル列に平行して形成されている同図(c)には透視的に二点鎖線で示すインク供給溝5(図6(c),(d)も参照)に、夫々対応する色のインクが、インク供給路18、インク受給孔6を介してインクタンク17-1又は17-2から供給される。

【0028】図9は、上記親基板16のインク供給路18と、印字チップ1のインク受給孔6との配設位置の関係を拡大して示す図である。同図は要部のみを分かりやすく示すため印字チップ1及びノズル列14'を破線で示している。同図に示すように、各印字チップ1の夫々4列のノズル列14'の各列毎に夫々対応する3個のインク受給孔6が、これらに対応する色インクのインク供給路18上に配置されている。

【0029】

【発明が解決しようとする課題】しかしながら、上述したカラー印字ヘッド15の構成、すなわち親基板16へ千鳥配列した印字チップ1の配置では、主走査方向(図9の横方向)に1列に並ぶ各印字チップ1と印字チップ1の間には大きな無駄なスペースGができていて、そして、この印字空白部を埋めるために隣接の印字チップ1を上又は下にずらして全体として2列の印字チップ1を主走査方向に千鳥配列した配置となっている。その結果、カラー印字ヘッド15の副走査方向の幅が大きくなってしまいうという第一の欠点を有している。また、同図に示すように、8本ものインク供給路18が必要であり、これでは組み立て時及び保守時の手数が掛るばかりでなく、インクタンク17も2つ必要になってコストが増大するという第二の欠点を有していた。

【0030】本発明の課題は、上記従来の実情に鑑み、最小限の数のインク供給路を備え、無駄なスペースが無く短手方向の幅がより狭いマルチアレイ式インクジェット印字ヘッドを提供することである。

【0031】

【課題を解決するための手段】本発明のマルチアレイ式インクジェット印字ヘッドは、複数のインク吐出ノズルを直線状に配置した印字チップを所定方向に対して所定の角度 θ (但し、 $\theta \neq 0$)をもって複数配置して成るサブヘッドと、該サブヘッドを上記所定方向に対して直角方向に複数配置して構成される。

【0032】上記所定方向は、例えば請求項2記載のように、印字の主走査方向であり、また、例えば請求項3記載のように、印字の副走査方向となるように構成される。また、上記所定の角度 θ は、例えば請求項4記載のように、5度以上、45度以下であることが好ましい。

【0033】また、上記一つのサブヘッドに配置された複数の上記印字チップは、例えば請求項5記載のように、専用且つ単一のインク供給路を共有して構成される。また、上記インク吐出ノズルは、例えば請求項6記載のように、上記印字チップ内で第1の列と該第1の列の長手方向に所定距離aだけずれ且つ上記第1の列の短手方向に所定距離bだけ離れた第2の列とで構成される。

【0034】そして、例えば請求項7記載のように、上記印字チップ内の上記第1の列の内端部のインク吐出ノズルと上記第2の列の内端部のインク吐出ノズル間の上

【0046】図2は、上記第1の実施の形態における変形例を示す図である。同図に示す印字ヘッド30は、親基板31に、やや長尺の4色チップ32を斜めに傾けて複数個（同図の例では10個）配設されている。各4色チップ32には、ノズル列33が長手方向に1列になって4列配設されている。これら4列のノズル列33は、夫々イエロー（Ｙ）インク、マゼンタ（Ｍ）インク、シアン（Ｃ）インク、及び黒（Ｋ）インクを吐出する。ま

た、特に図示しないが、これらのノズル列33に対応する色のインクを供給するインク供給路は親基板31上に4本のみ形成されている。

【0047】同図に示す破線28及び破線29で区切られた内部のノズル列33の構成のみを見ると、これらのノズル列配置構成が図1(a),(b)に示した第1の実施の形態における印字ヘッド20のノズル列配置構成と同一であることが分かる。このように構成しても、図1の印字ヘッド20と同様の効果が得られ、且つ、親基板31に搭載する印字チップの数を、図1の印字ヘッド20と比較して、単純計算で1/4程度に減らすことができる。

【0048】図3(a)は、第2の実施の形態に係る印字チップの概略の平面図であり、同図(b)は、その印字チップを配設した印字ヘッドを示す図、同図(c)は、その親基板のインク供給路と接着シーリング材の連通孔の配置と形状を示す図、同図(d)は、同図(b)の一部拡大図である。

【0049】同図(a)に示すように、この印字チップ35は、多数のインク吐出ノズル34からなる2列のノズル列36(36-1、36-2)を備えている。これらノズル列36は、第1の列としてのノズル列36-1と、このノズル列36-1の長手方向に所定距離aだけずれ且つノズル列36-1の短手方向に所定距離bだけ離れた第2の列としてのノズル列36-2とで構成される。

【0050】このような印字チップ35が、この場合も図の両方向矢印Mで示す主走査方向に斜めに傾いた状態で、親基板37に配設される。そして、その主走査方向に並ぶ複数の印字チップ35によって形成される1つのサブヘッド38(38-1、38-2、38-3又は38-4)が副走査方向に4列並んで印字ヘッド40を構成している。この場合も、印字チップ35の傾き角度 θ は、主走査方向に対して5度以上、45度以下である。

【0051】この場合も夫々のサブヘッド38の印字チップ35が斜めに傾いて入り組んでいるので、上下左右に隣接する各印字チップ35の間に大きな間隙が無く、その分だけ印字ヘッド40の副走査方向の幅Nが図7に示した従来のカラー印字ヘッド15の副走査方向の幅F(図9参照)よりも狭くなっている。

【0052】そして、この親基板37には、同図(c)に示すように、不図示の1個のインクタンクのイエロー(Y)、マゼンタ(M)、シアン(C)及び黒(K)の4つのインク貯留室に夫々連通する4本のインク供給路41(41-1、41-2、41-3、41-4)が形成されている。

【0053】これらインク供給路41の上に配置される印字チップ35との間に介装される接着シーリング材には、インク供給路41の両端部では一方の端部の印字チップ35-1のノズル列36-1のインク受給孔に対応

する細長くやや短いインク連通孔42aと他方の端部の印字チップ35-k(k:1つのサブヘッド38に配設される印字チップ数)のノズル列36-2のインク受給孔に対応する細長くやや短いインク連通孔42bとが形成され、両端部以外の中間の部分では、印字チップ35-q(q=2、3・・・、k)のノズル列36-1と印字チップ35-q-1のノズル列36-2と共有される段差付きで細長く伸びるインク連通孔43とが形成されている。

【0054】このように、各サブヘッド38は、夫々1色のインクに対応する1本のインク供給路41と、この上に斜めに傾けて配設されたk個の印字チップ35からなっており、印字ヘッド40全体としては、この場合も4本のみインク供給路41-1~41-4で構成されている。

【0055】そして、上記各サブヘッド38毎に主走査方向に複数(k個)ある印字チップ35は、専用且つ単一のインク供給路41を共有するように構成され、例えば、同図(c)に示すように、サブヘッド38-1の各印字チップ35はイエロー(Y)インク、サブヘッド38-2の各印字チップ35はマゼンタ(M)インク、サブヘッド38-3の各印字チップ35はシアン(C)インク、そしてサブヘッド38-4の各印字チップ35は黒(K)インクに対応している。

【0056】このように構成しても、この図3(b)と前述の図1(a)を見比べて分かるように、親基板内における個々のノズル列の配置は同一である。また、上記斜めに傾いた印字チップ35の配置において、同図(d)に示すように、同一サブヘッド内で隣接する印字チップ35と35の夫々のノズル列36-2と36-1の、互いに近接する端部のインク吐出ノズル34-m(m:ノズル列36内のインク吐出ノズル配列数)と34-1間の主走査方向のピッチd3、同一ノズル列36(例として同図(d)のノズル列36-1)内のインク吐出ノズル34同士間のピッチd1、及び同一印字チップ35内のノズル列36-1の内端部のインク吐出ノズル34-mとノズル列36-2の内端部のインク吐出ノズル34-1間の主走査方向のピッチd2は、いずれも同一となるように構成されている。

【0057】また、同一サブヘッド内に並ぶ各印字チップ35のノズル列36-1の外端部のインク吐出ノズル34-1とノズル列36-2の内端部のインク吐出ノズル34-1は主走査方向に一直線をなして配置され、同じく各印字チップ35のノズル列36-1の内端部のインク吐出ノズル34-mとノズル列36-2の外端部のインク吐出ノズル34-mも主走査方向に一直線をなして配置される。

【0058】いずれのサブヘッド38においても、その印字チップ35のノズル列36-1及び36-2の各端部のインク吐出ノズル34-1と隣接のサブヘッド38

の印字チップ35のノズル列36-1及び36-2の各端部のインク吐出ノズル34-mとの副走査方向の距離 e を0.5mm以上とすることが好ましい。この距離 e は、各サブヘッド38のノズル列36-1及び36-2によって吐出されるインクの、色の異なるインクとインク間の距離に対応しており、この距離 e を0.5mm以上とすることで、不図示のワイパーでサブヘッドを主走査方向にワイピングする際にインクの混色を防止することができる。

【0059】図4(a)は、上記同一サブヘッド内における印字チップ35の傾斜配置において好ましい配置を示しており、同図(b)は、このように配置しても構わないが好ましいとはいえない配置を示している。すなわち、同図(a)に示す印字チップ配置は、印字チップ35-qのノズル列36-2の外端部のインク吐出ノズル34-mと隣接の印字チップ35-q+1のノズル列36-1の外端部のインク吐出ノズル34-1間の副走査方向の距離 f は、同一印字チップ35(例えば同図(a)の印字チップ35-q+1)のノズル列36-1の内端部のインク吐出ノズル34-mとノズル列36-2の内端部のインク吐出ノズル34-1間の副走査方向の距離 g と同一の距離「 $f=g$ 」となるように配置されている。このように配置すると、各印字チップ35のノズル列36-1及び36-2からなる同一サブヘッド内のノズル列群の副走査方向の位置関係が全て同じになるので、印字制御部の回路またはプログラムの構成をより簡単化することができる。

【0060】これに対して、同図(b)に示すように、同一印字チップ内のノズル列間の距離 f' と隣接印字チップのノズル列間の距離 g' が異なるような配置であると、ノズル列毎の吐出タイミングの制御が複雑になって面倒である。

【0061】図5(a)、(b)は、上記第2の実施の形態における変形例を示す図である。同図(a)に示す印字ヘッド45は、親基板46に、長尺の4色印字チップ47を斜めに傾けて複数個(同図の例では10個)配設されている。

【0062】同図(b)に示すように、4色印字チップ47は、インク吐出ノズル48が、4色印字チップ47内で、第1の縦4列を形成する4列のノズル列49-1 a、49-1 b、49-1 c及び49-1 dと、第1の縦4列の長手方向に所定距離 j だけずれ且つ第1の縦4列の短手方向に所定距離 k だけ離れた第2の縦4列である4列のノズル列49-2 a、49-2 b、49-2 c及び49-2 dを形成している。

【0063】この場合も、同図(a)に示す破線51及び破線52で区切られた内部のノズル列49-1 d、49-2 d等の配置のみを見ると分かるように、図3(b)又は図1(a)に示した構成と、親基板46内における個々のノズル列の配置は同一である。すなわち、これによ

ても、副走査方向の幅が狭く、インク供給路が4本のみの印字ヘッド45が形成される。

【0064】尚、上述した実施の形態では、いずれも印字ヘッドの長手方向を印字の主走査方向とするラインプリンタ用の印字ヘッドとして説明しているが、本発明の印字ヘッドは、これに限ることなく、印字ヘッドの長手方向を副走査方向として、シリアルプリンタ用の印字ヘッドに適用できることは勿論である。

【0065】

【発明の効果】以上詳細に説明したように、本発明によれば、少なくとも1列のノズル列を有する印字チップを所定角度傾けて親基板に複数配設するので、印字チップ間の無駄なスペースを可及的に少なくでき、これにより、印字ヘッドの短手方向の幅を従来よりも小さくすることができると共にインクの色数だけのインク供給路の構成でよくなり、したがって、プリンタ本体をより小型化できると共に、組み立て時及び保守時の手数が掛らず低コストなマルチアレイ式インクジェット印字ヘッドを提供することが可能となる。

【図面の簡単な説明】

【図1】(a)は第1の実施形態におけるマルチアレイ式インクジェット印字ヘッドの印字チップ配置図、(b)はその拡大図、(c)は更に一部を拡大して示す図である。

【図2】第1の実施の形態における変形例を示す図である。

【図3】(a)は第2の実施形態に係る印字チップの概略の平面図、(b)はその印字チップを配設した印字ヘッドを示す図、(c)はその親基板のインク供給路と接着シーリング材の連通孔の配置と形状を示す図、(d)は(b)の一部拡大図である。

【図4】(a)は第2の実施形態に係る印字チップの同一サブヘッド内における好ましい傾斜配置を示す図、(b)はあまり好ましいとはいえない配置を示す図である。

【図5】(a)、(b)は第2の実施形態における変形例を示す図である。

【図6】(a)は従来の印字チップのインク吐出面を示す平面図、(b)はその背面図、(c)は(a)の一点鎖線aで囲んだ部分の内部を示す拡大図、(d)は(c)のA-A'断面矢視図である。

【図7】従来のライン式プリンタのカラー印字ヘッドの構成を模式的に示す図である。

【図8】(a)は従来のカラー印字ヘッドの親基板に配置される印字チップへインクを供給するインク供給路の構成を示す図、(b)は(a)のC-C'断面拡大矢視図、(c)は印字チップを示す図、(d)はそのD-D'断面拡大矢視図である。

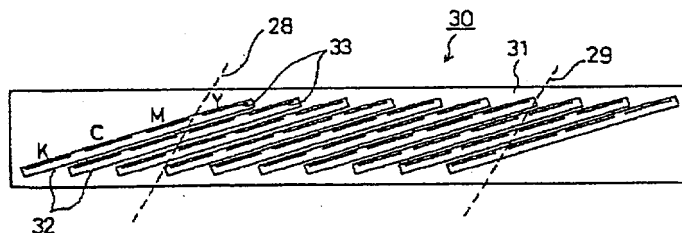
【図9】従来のカラー印字ヘッドの親基板のインク供給路と印字チップのインク受給孔との配設位置の関係を拡大して示す図である。

【符号の説明】

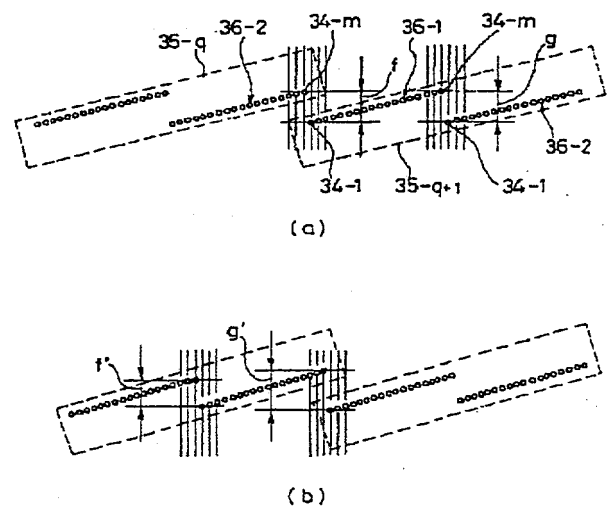
- 1 印字チップ
- 2 ノズル列
- 3 シリコンチップ基板
- 4 駆動回路
- 4-1 電極端子
- 5 インク供給溝
- 6 インク受給孔
- 7 発熱素子
- 8 配線電極
- 8a 共通電極
- 8b 個別配線電極
- 9 縁部
- 10 接続用電極端子
- 11 隔壁
- 11-1 突設部
- 12 インク加圧室
- 13 オリフィス板
- 14 インク吐出ノズル
- 14' ノズル列
- 15 カラー印字ヘッド
- 16 親基板
- 17 (17-1、17-2) インクタンク
- 18 インク供給路
- 20 印字ヘッド
- 21 親基板
- 22、22-i ($i=1、2、\dots、13$) 印字チップ
- 23 (23-1、23-2、23-3、23-4) サ

- ブヘッド
- 24 (24-1、24-2、24-3、24-4) インク供給路
- 25 インク連通孔
- 26 ノズル列
- 27-j ($j=1、2、\dots、n$) インク吐出ノズル
- 30 印字ヘッド
- 31 親基板
- 32 4色チップ
- 33 ノズル列
- 34、34-1、34-m インク吐出ノズル
- 35、35-1、35-k、35-q ($q=2、3、\dots、k$) 印字チップ
- 36 (36-1、36-2) ノズル列
- 37 親基板
- 38 (38-1、38-2、38-3、38-4) サブヘッド
- 40 印字ヘッド
- 41 (41-1、41-2、41-3、41-4) インク供給路
- 42a、42b、43 インク連通孔
- 45 印字ヘッド
- 46 親基板
- 47 4色印字チップ
- 48 インク吐出ノズル
- 49 ノズル列

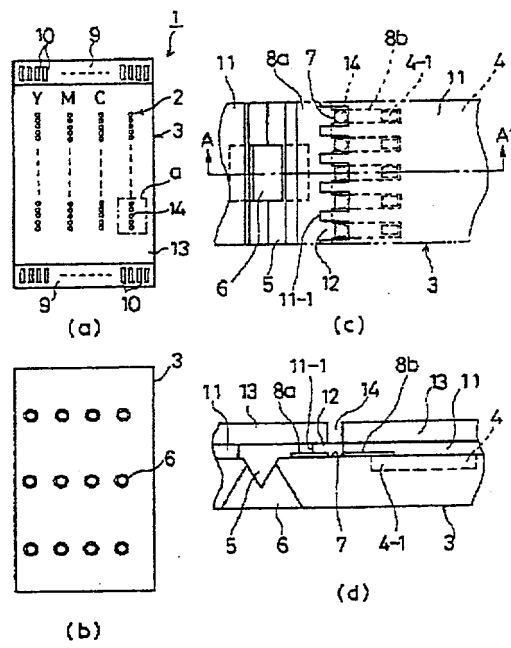
【図2】



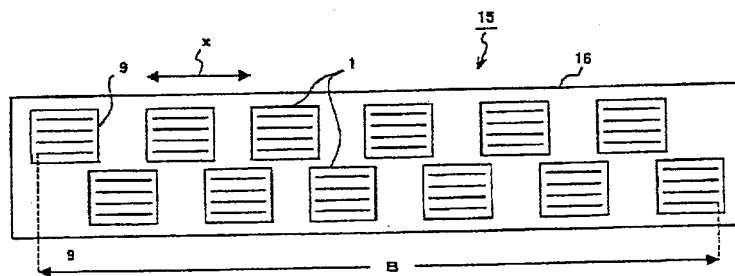
【図4】



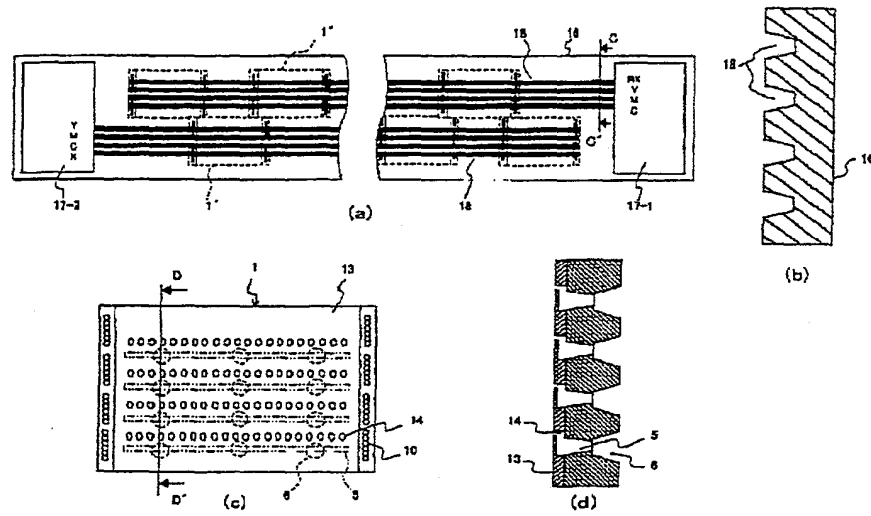
【图6】



【图7】



【図 8】



【図 9】

